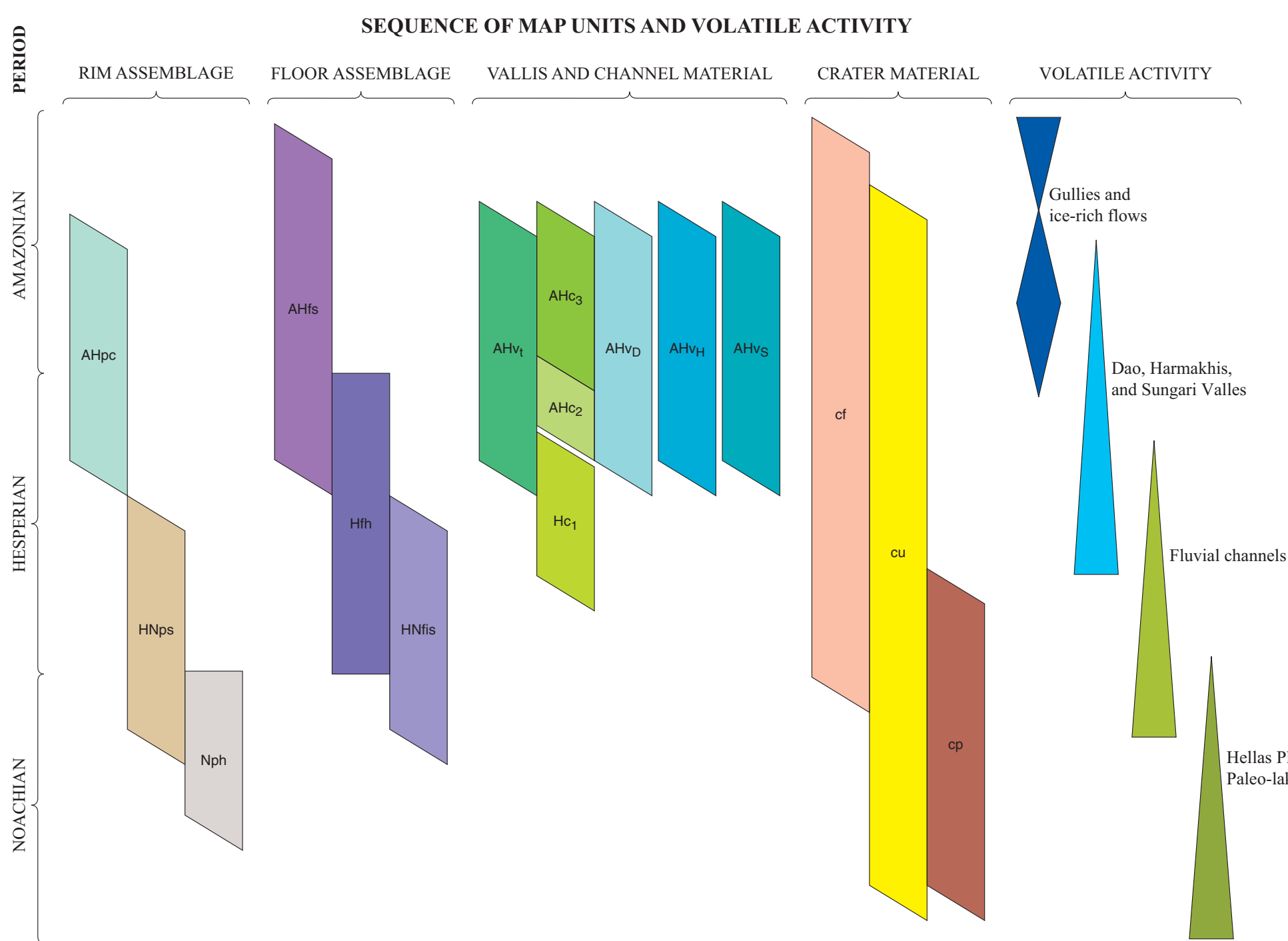


Descriptions of nomenclature used on map are listed at <http://planetarynames.usgs.gov/>

SCALE 1:1,004,000 (1 mm = 1.004 km) AT 270° LONGITUDE
TRANSVERSE MERCATOR PROJECTION
KILOMETERS
Planitocentric latitude and east longitude coordinate system shown in black.
Planetographic latitude and west longitude coordinate system shown in red.

Prepared on behalf of the Planetary Geology and
Geophysics Program, Solar System Exploration
Division, Office of Space Science, National Aeronautics
and Space Administration
Edited by Jan L. Zeller; cartography by Debra A. Ryan
Manuscript approved for publication October 14, 2009



DESCRIPTION OF MAP UNITS

RIM ASSEMBLAGE

AHpc **Channelled plains material (Amazonian to Hesperian)**—Smooth to irregular surfaces characterized by small-scale sinuous channels, ridges, and scarps; lightly cratered. *Type Locality:* (lat 45.5° S, long 271.3° W). *Interpretation:* Sediments deposited as result of erosion of surrounding highlands to the east and of Hellas Planitia rim terrain; redistributed to form smooth and scoured (to the) surfaces. Uncertainty regarding exact location of contact with unit HNps results from presence of poorly consolidated sediments and Amazonian mid-latitude mantling deposits. Some concentrations of sediments and volatiles may be related to development of Reull Vallis to the east of the map area or Hellas Planitia paleolakes.

HNps **Smooth plains material (Hesperian to Noachian)**—Plains of slight to moderate relief cut by narrow, sinuous channels and linear to arcuate troughs. Forms low-relief plateau with a moderate albedo in Viking and THEMIS visible datasets; exhibits ridges and curvilinear to irregular scarps, many along the margins of Dao Vallis. Stipple pattern marks regions of downropped blocks of smooth plains material that preserve primary surface characteristics. *Type Locality:* (lat 41° S, long 273.8° W; blocks at lat 38.8° S, long 272.8° W). *Interpretation:* Sedimentary deposits derived from surrounding terrains and possible volcanic material; large irregular blocks represent initial stages of canyon widening due to fracturing, sagging, collapse, and possible devolatilization.

Nph **Hummocky plains material (Noachian)**—Irregular surfaces of moderate relief; moderately to heavily cratered and cut by numerous channels and scarps; mottled appearance with high-standing knobs, ridges, troughs, and layered outcrops along scarps; low albedo relative to smooth plains material (unit HNps) in Viking and THEMIS visible images; highly variable thermophysical signature in THEMIS infrared images. Diamonds indicate layered materials observed in high-resolution MOC images, see figure 5. *Type Locality:* (lat 38.1° S, long 275.3° W). *Interpretation:* Sedimentary and volcanic deposits with some remnants of rugged highlands. Irregular surface morphology, albedo, and thermophysical mottling result from deformation, deflation, fluvial downcutting, scarp retreat, and collapse of layered, possibly water-ice-rich, materials. Heavily cratered, melting on floor of Hellas Planitia (lat 46° S, long 275.5° W) represents lateral continuation of rim assemblage underneath smooth floor deposits (unit HNps); Hellas basin floor exposure displays both old, degraded crater rims, as well as superposed fresh craters, indicating some removal of a cover material, possibly unit AHpc. Current surface morphology appears to be dominated by aeolian deflation, devolatilization, and collapse.

FLOOR ASSEMBLAGE

AHfs **Smooth fill material (Amazonian to Hesperian)**—Smooth, relatively featureless surface in Viking and THEMIS visible images, confined to topographic depressions marking the extensions of Harkniss Vallis onto Hellas Planitia. Depressions have sinuous to braided nature. *Type Locality:* (lat 42.9° S, long 275.5° W). *Interpretation:* Significantly thick deposits (enough to obscure hummocky nature of unit HNps) of fine material resulting from mass wasting and aeolian deposition.

HNfs **Hummocky floor material (Hesperian)**—Irregular surface with moderate relief; specifically near concentrations of narrow troughs, found adjacent to and around scarp-bound mesas of smooth interior floor within Hellas Planitia (unit HNps). Outcrops contained within topographic depressions at terminus of Harkniss Vallis. Superposed by smooth fill material (unit AHfs). *Type Locality:* (lat 42.8° S, long 276.5° W). *Interpretation:* Combination of remnant smooth interior deposits, Harkniss Vallis terminal deposits, and underlying rock material. Represents breakup and removal of smooth interior deposits; includes materials mass-wasted from adjacent mesas.

HNis **Smooth interior floor material (Hesperian to Noachian)**—Broad annular region in eastern Hellas Planitia characterized by smooth to irregular surfaces (in Viking and THEMIS data) with rectilinear to polygonal ridge patterns, moderately to heavily cratered. Locally forms scarp-bound mesas. Clearly embayed by terminal deposits from Dao Vallis (unit AHVt) but has gradational boundary with channelled plains (unit AHpc) to the east and with other vallis materials (units AHVd, AHVh, AHVs). Stipple pattern marks area of anomalously high retention of small to moderately sized craters, including those with dark albedo and thermophysical characteristics similar to those of unit Nph. *Type Locality:* (lat 46.7° S, long 274.4° W). *Interpretation:* Sedimentary and volcanic materials eroded from eastern Hellas Planitia rim and deposited on basin floor. Deposits drape underlying topography and wrinkle ridges; localized removal of material exposes older striated ejecta blankets and rugged wrinkle-ridge morphology. Some ridges form circular patterns consistent with buried crater rims. Materials possibly transported through pro-Dao and proto-Harkniss Vallis (and other vallis systems) and deposited in a widespread lacustrine environment across the basin floor. Current outcrop pattern, specifically near Harkniss Vallis, controlled by paleolocation of Harkniss' terminal branches. Larger, superposed craters penetrate deep enough to excavate the underlying unit Nph materials; relatively smaller craters of unit Nph are morphologically subdued (several craters completely blanketed by surficial materials but maintain topographic expression as circular ridges). Widespread mantling by aeolian fines and atmospheric frosts, especially south of latitude 40° S.

VALLIS AND CHANNEL MATERIAL

AHVt **Vallis terminal material (Amazonian to Hesperian)**—Irregular surface; moderate albedo in Viking and THEMIS visible images; minor topographic rise at lobate rim margins. *Type Locality:* (lat 39.75° S, long 278.25° W). *Interpretation:* Sedimentary material deposited at mouth of Dao Vallis by fluvial, nival, glacial, and (or) debris-flow processes. Represents the most recent contributions of material from the rim to the floor.

Channel floor material (Amazonian to Hesperian)

AHc3 **Member 3 (Amazonian to Hesperian)**—Smooth surfaces in elongate, sinuous channels; low albedo. Occurs on floors of youngest through-cutting canyons and channels superposing the vallis terminal material at the mouth of Dao Vallis. *Type Locality:* (lat 39.6° S, long 277.8° W). *Interpretation:* Fluvial, aeolian, and (or) mass-wasted materials deposited in narrow topographic lows.

AHc2 **Member 2 (Amazonian to Hesperian)**—Smooth surfaces in truncated channel segments. Channels typically have narrow, sinuous forms, but also show widening in some locations as open canyons. *Type Locality:* (lat 39.05° S, long 275° W). *Interpretation:* Channel floor containing deposits of fluvial, aeolian, and (or) mass-wasted material; widening caused by wall collapse. Channel segments reflect drainage along Hellas Planitia rim, some may represent abandoned pathways of Dao Vallis paleochannels.

HNc1 **Member 1 (Hesperian)**—Smooth surfaces in truncated channel segments. Occurs along trend of several small surface channels. Channels typically have narrow, sinuous forms but also show widening in some locations as open canyons. *Type Locality:* (lat 39.3° S, long 274° W). *Interpretation:* Channel floor containing deposits of fluvial, aeolian, and (or) mass-wasted material; widening caused by wall collapse. Channel segments reflect drainage along Hellas Planitia rim, some may represent abandoned pathways of paleochannels.

AHVd **Dao Vallis floor material (Amazonian to Hesperian)**—Smooth materials on floor of elongate, relatively steep walled, sinuous canyon; linear and curvilinear features parallel canyon margins. *Type Locality:* (lat 39.4° S, long 273.55° W). *Interpretation:* Materials derived from surrounding units, canyon walls, and (or) aeolian deposition; modified by small-scale deflation and redistribution. Lineations may be related to flow of water/ice-rich materials downcanyon or due to convergence of debris shed from adjacent walls.

AHVh **Harkniss Vallis floor material (Amazonian to Hesperian)**—Smooth materials on floor of elongate, relatively steep walled, sinuous canyon; surface lineations and chains of pits parallel canyon margins. *Type Locality:* (lat 41.9° S, long 271.6° W). *Interpretation:* Materials derived from surrounding units, canyon walls, and (or) aeolian deposition, modified by small-scale deflation and redistribution; lineations either from flow of water/ice-rich materials downcanyon or from convergence of debris shed from adjacent walls; pits from loss of volatiles or from collapse of surface materials over subsurface volatile pathways.

AHVh **Sungari Vallis floor material (Amazonian to Hesperian)**—Smooth materials on floor and at terminus of narrow, elongate, sinuous canyon. *Type Locality:* (lat 40.25° S, long 272.15° W). *Interpretation:* Canyon floor containing deposits of fluvial, aeolian, and (or) mass-wasted material.

CRATER MATERIAL

cf **Crater-rim material (Amazonian to Noachian)**—Smooth, relatively featureless surfaces on crater floors. Some surfaces have lineated and concentric patterns and (or) lobate margins extending from crater walls. *Type Locality:* (lat 41.1° S, long 272.65° W). *Interpretation:* Fluvial, aeolian, and (or) mass-wasted deposits accumulated on the crater floor; lobate margins and lineated features most likely from downslope flow and primary deposition; concentric patterns possibly from episodic deposition and (or) erosion.

cu **Crater material, undivided (Amazonian to Noachian)**—Fresh to highly eroded rim, floor, and ejecta materials. Ejecta deposits commonly lobate; some have pedestal morphology and striated ejecta blankets. Some are superposed on and some protrude through Hellas floor materials. Crosshatch pattern indicates dark-albedo material (in Viking and THEMIS visible datasets) within ejecta blankets. *Type Locality:* (lat 43.8° S, long 276.25° W). *Interpretation:* Material displaced and redeposited by impacts; low-albedo material excavated from unit Nph.

cp **Crater-peak material (Hesperian to Noachian)**—Rugged, topographically elevated, uneven material near centers of impact craters. *Type Locality:* (lat 44.3° S, long 276.75° W). *Interpretation:* Material uplifted during lithospheric rebound of basement rock during impact event.

- Contact — Dashed where approximately located; dotted where buried. Internal contact delineates deposits of different impacts.
- Ridge crest —
- Subdued ridge crest — Visible in MOLA topography
- Scarp top — Hachures point downslope
- Narrow trough —
- Vallis floor lineations —
- Crater ejecta lineations —
- Crater rim — Showing crest. Dashed where buried
- Subdued crater rim —
- Location, finely layered outcrop —
- Collapsed plains —
- Anomolously high concentration of mantled craters —
- Dark albedo ejecta material —

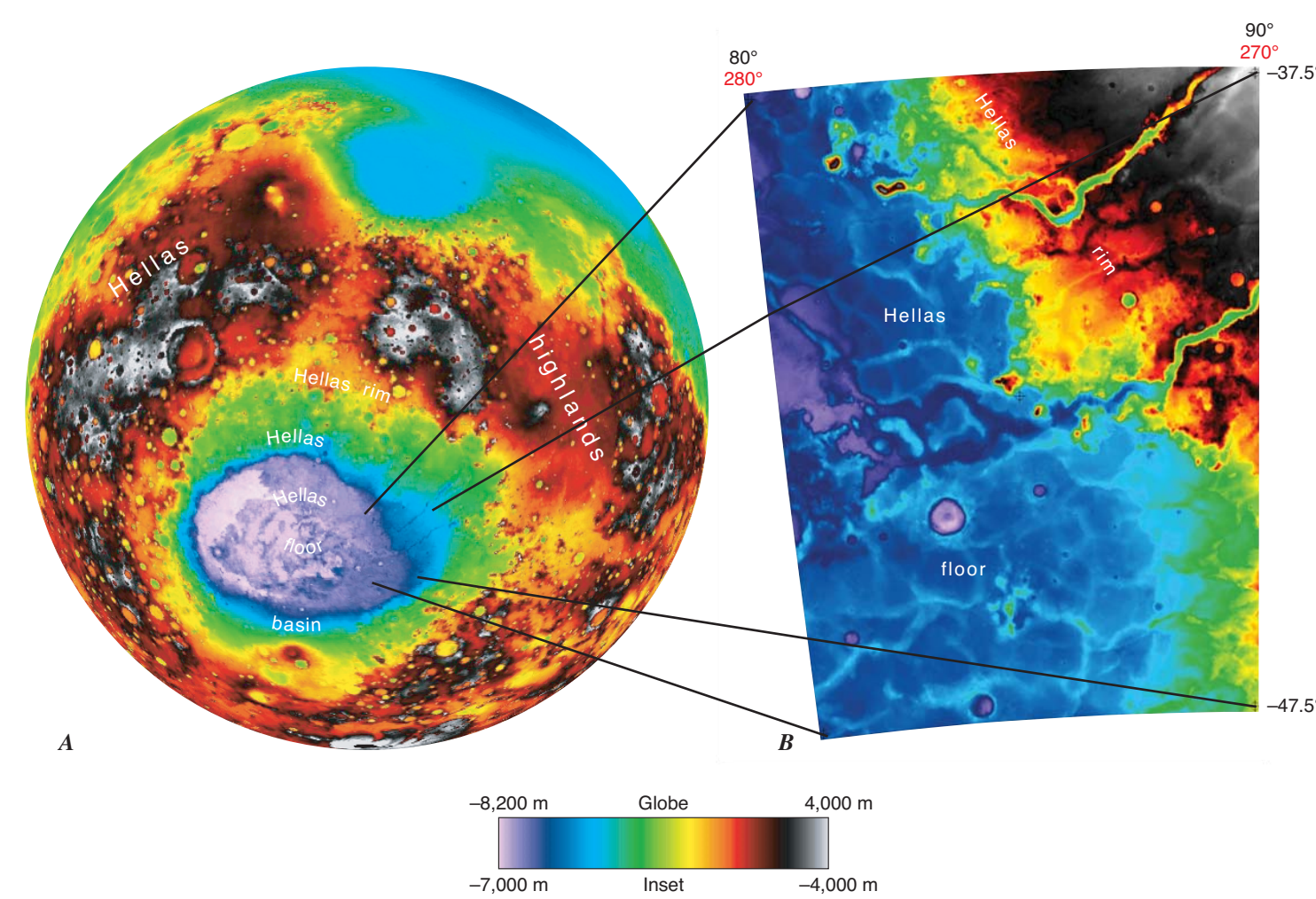


Figure 1. (A) Hellas Planitia extends across ~50° in longitude (long ~46° to 95° E) and more than 20° in latitude (lat ~32° to 55° S). The ~4,000 m elevation contour roughly defines the topographic depression of the Hellas basin. (B) MTM -40277, -45277, and -40272 quadrangles traverse the eastern rim of Hellas Planitia and display ~3 km of relief, including the transition from rim to floor. Mars Orbiter Laser Altimeter (MOLA) DEMs (128 px/degree, ~464 px/px). Note locations of informally named features discussed in report.

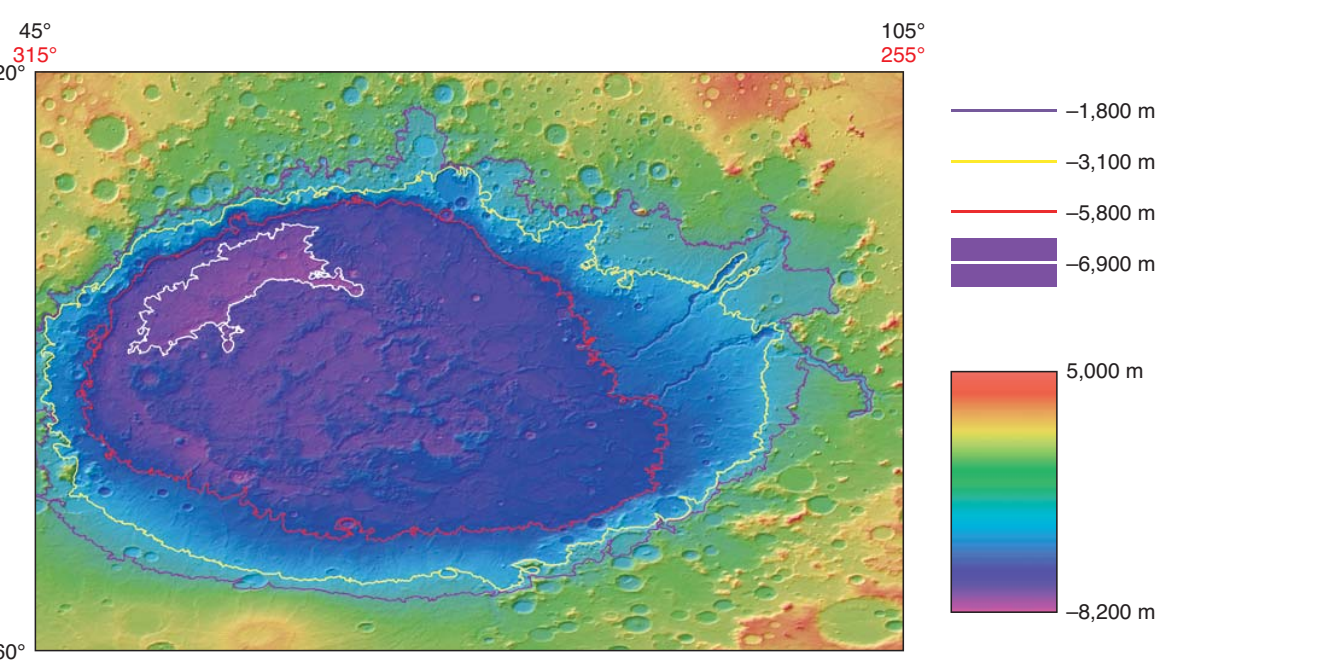


Figure 2. MOLA 128 pixel/degree DEM with contour intervals or shorelines: -6,900 m, -5,800 m, and -3,100 m (Moore and Wilhelm, 2001, 2007) and -1,800 m (Crown and others, 2005). Shorelines follow and are characterized by distinct changes in surface morphology, including crater retention.

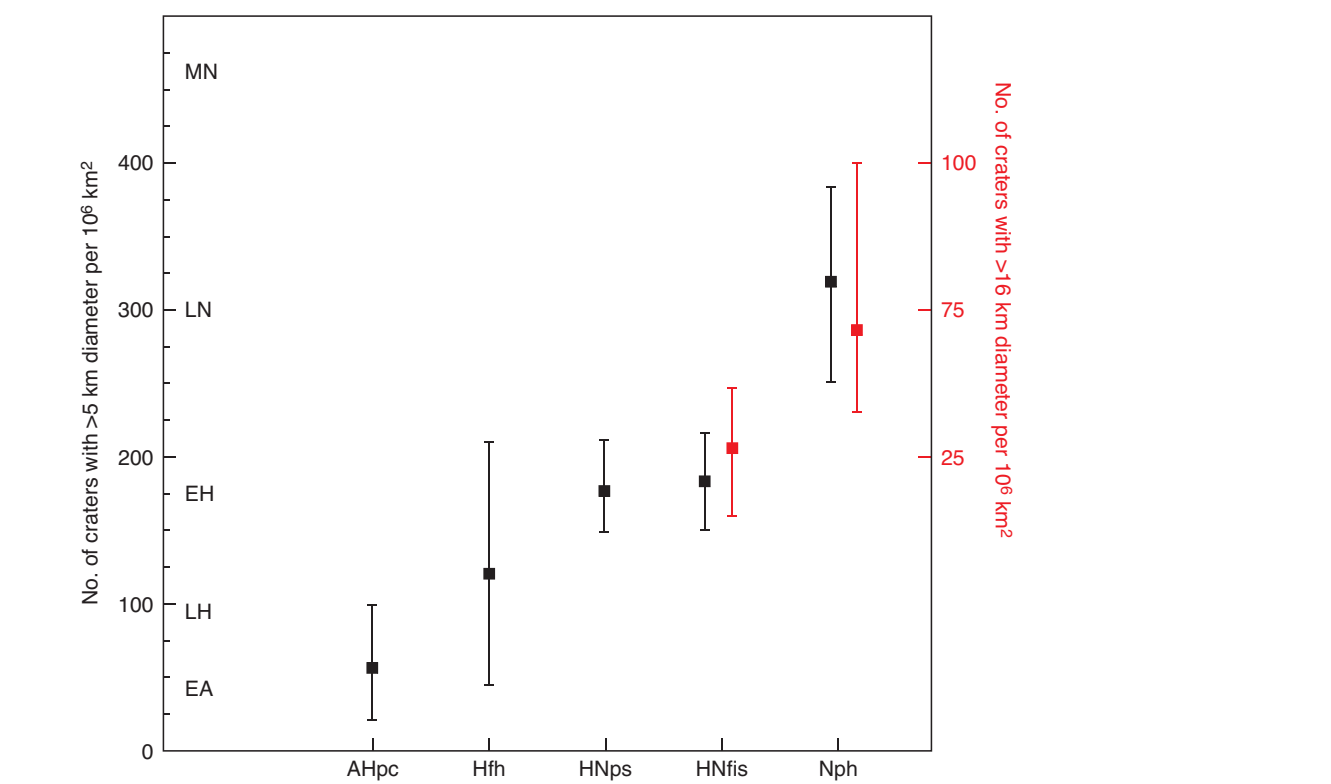


Figure 3. Graphical representation of N(5) (black) and N(16) (red) size frequency distributions for major geologic units. N(16) scale is nonlinear, but age divisions (Tanaka, 1986) correlate with N(5) divisions. Periods: N, Noachian; H, Hesperian; A, Amazonian. Epochs: E, Early; M, Middle; L, Late.

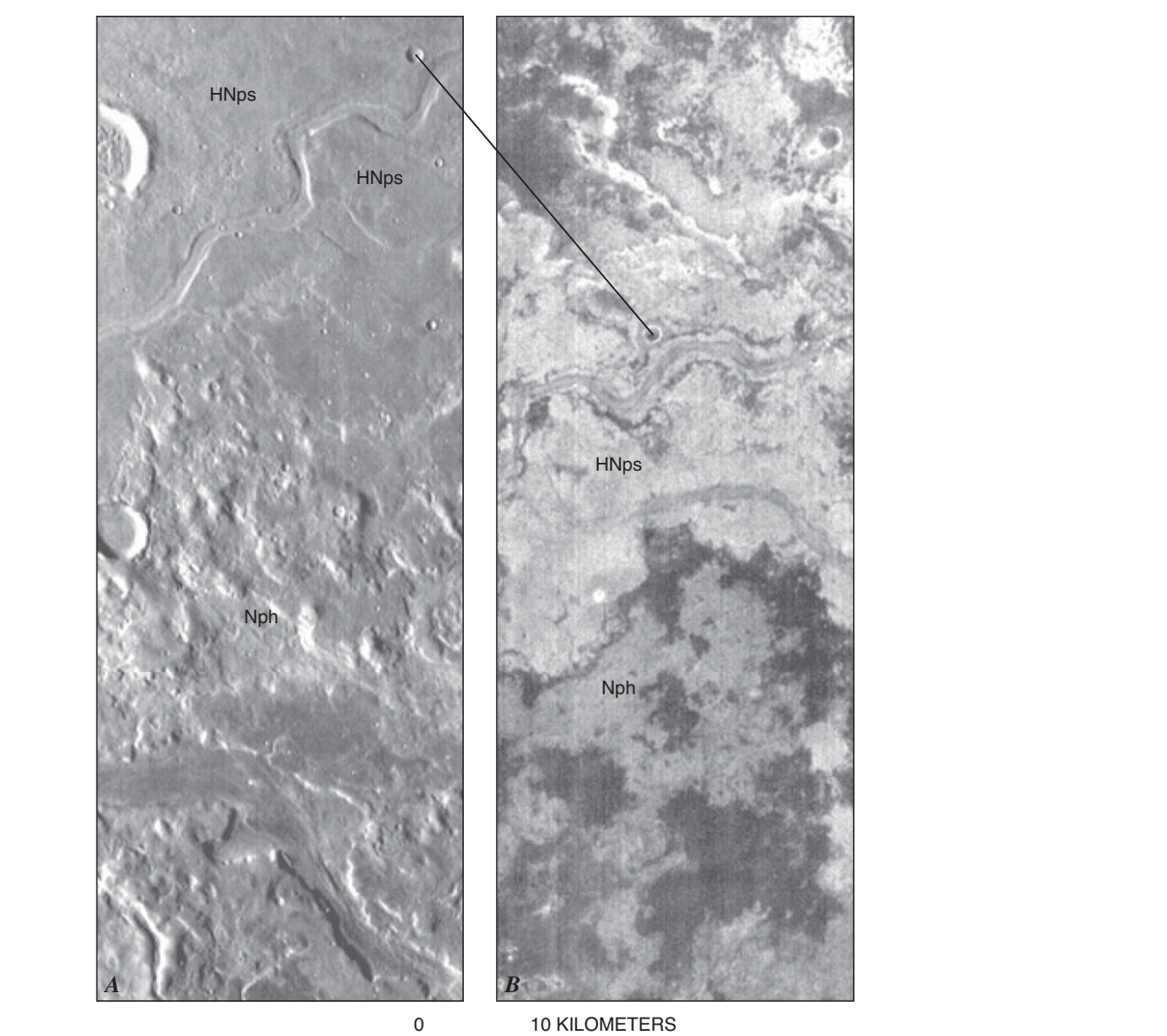


Figure 4. Parts of THEMIS daytime IR 07937005 (A; image center, lat 47.42° S, long 277.23° W) and nighttime IR 08001808 (B; image center, lat 35.07° S, long 275.54° W) images illustrate the morphological and thermophysical differences between the smooth (HNps) and hummocky (Nph) plains materials (line connects common crater in each image; image widths ~30.5 km). Image locations shown on map.

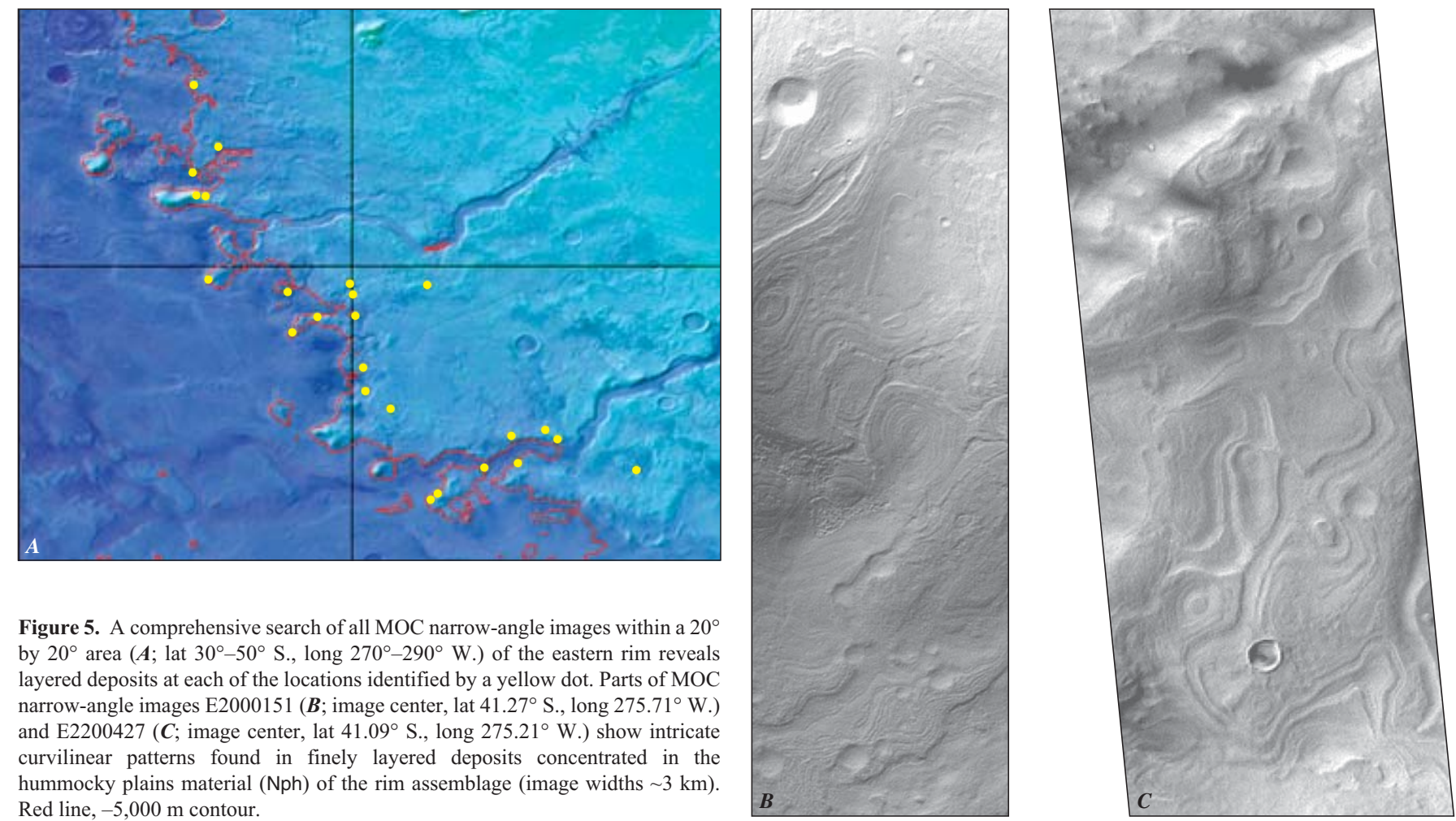


Figure 5. A comprehensive search of all MOC narrow-angle images within a 20° by 20° area (A; lat 30°-50° S, long 270°-290° W) of the eastern rim reveals layered deposits at each of the locations identified by a yellow dot. Parts of MOC narrow-angle images E2000151 (B; image center, lat 41.27° S, long 275.71° W) and E2200427 (C; image center, lat 41.09° S, long 275.21° W) show intricate curvilinear patterns found in finely layered deposits concentrated in the hummocky plains material (Nph) of the rim assemblage (image widths ~3 km). Red line, ~5,000 m contour.

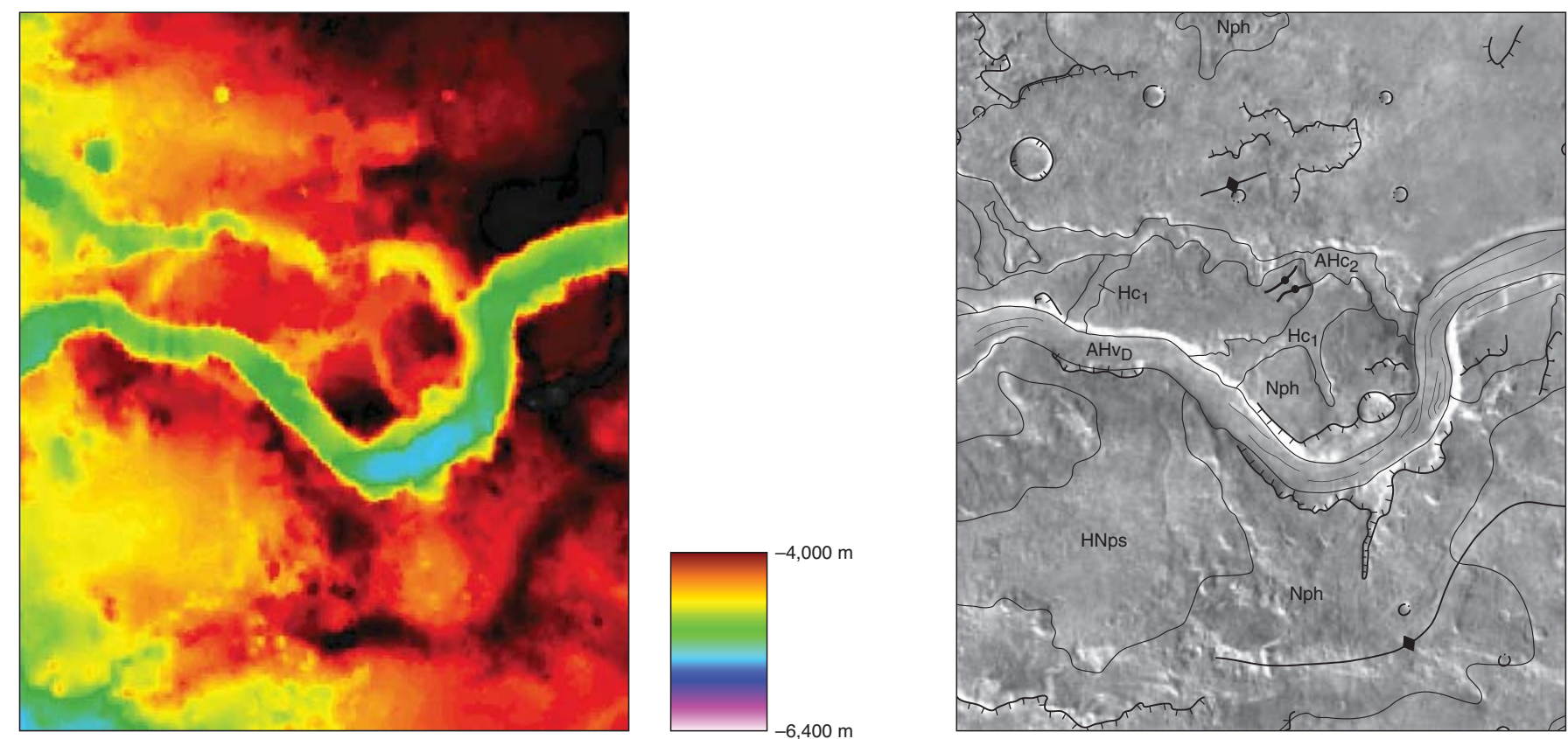


Figure 6. MOLA DEM (left) and Viking MDM 2.1 (right) showing several truncations along Dao Vallis on the eastern rim of Hellas basin. Image locations shown on map. See map symbol explanation at end of Description of Map Units.

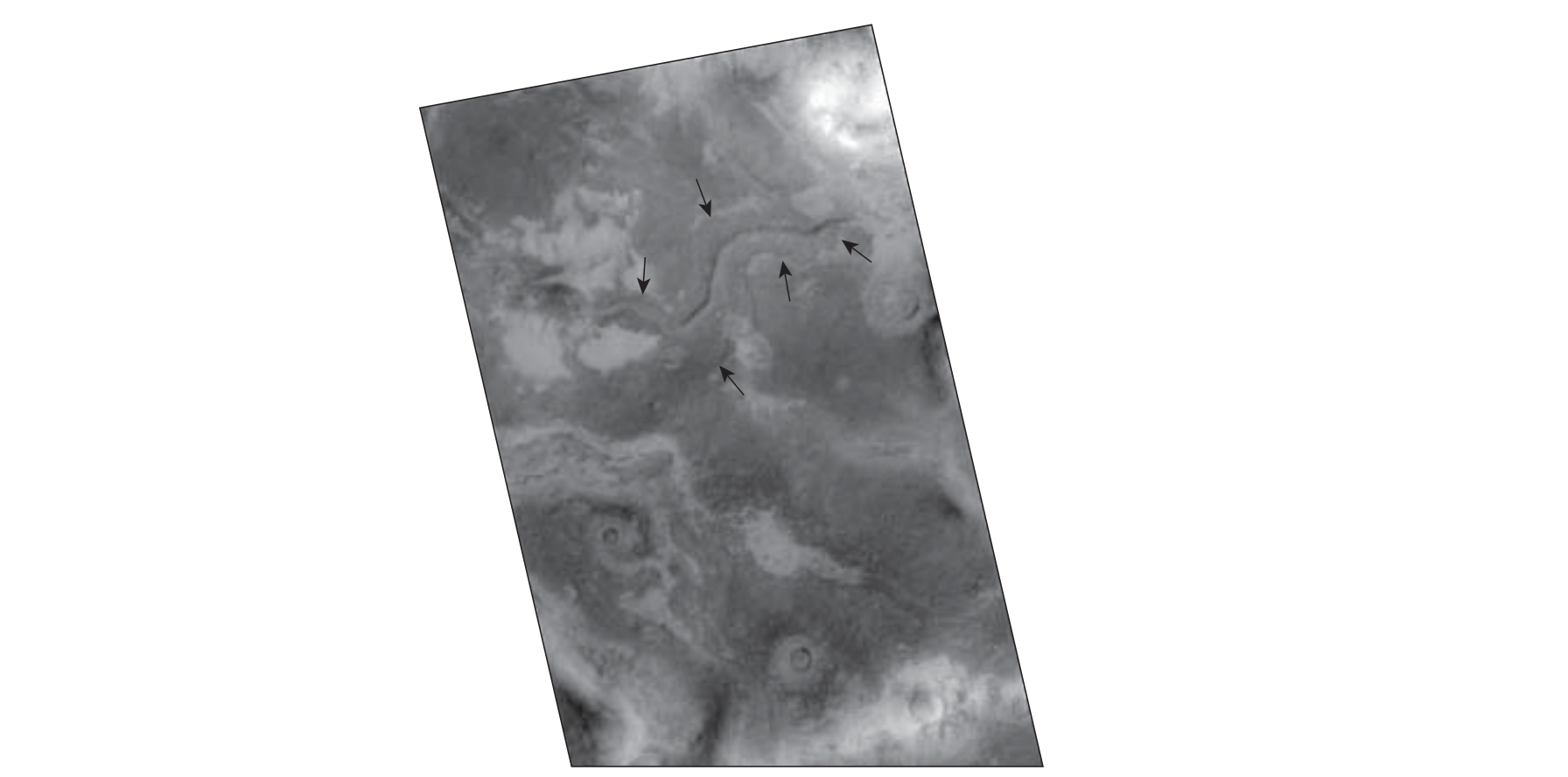


Figure 7. Part of MOC wide-angle image M1202662 shows what may be the only traceable vallis deposits on the floor of Hellas Planitia. Arrows point to the raised margins. Parallel nature of the incised channel and the deposit margins suggest that the two are genetically linked (image width ~113 km). Image location shown on map.

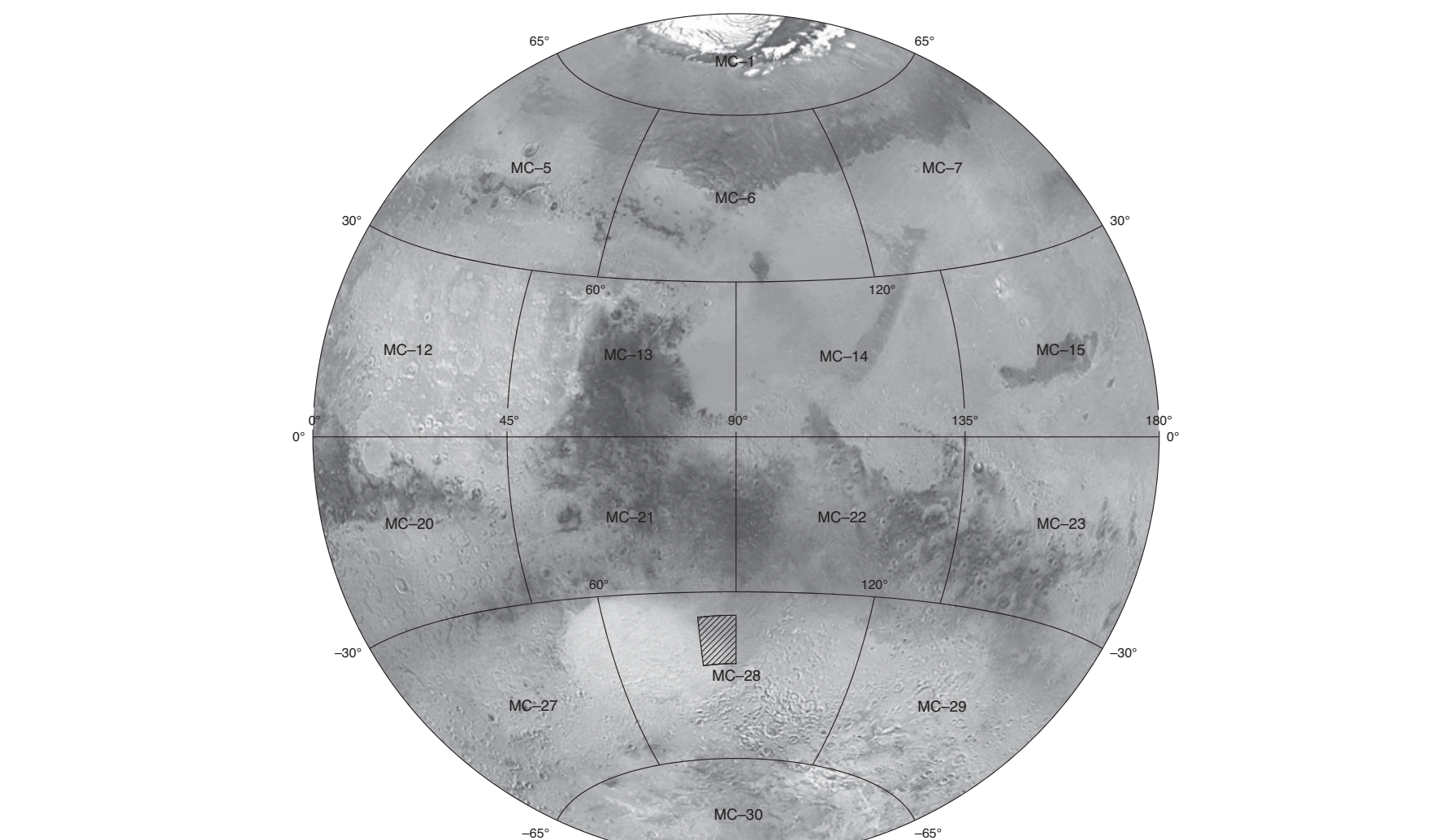


Figure 8. Photomosaic showing location of map area. An outline of 15,000,000 scale quadrangles is provided for reference.

Geologic Map of MTM -40277, -45277, -40272, and -45272 Quadrangles, Eastern Hellas Planitia Region of Mars

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2010

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